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PROVISIONAL APPLICATION FOR PATENT
COVER SHEET

Case No. 3WARE.011PR
Date: August 11, 2000
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ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

ATTENTION: PROVISIONAL PATENT APPLICATION

Sir:

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR § 1.53(c).

For: **ARCHITECTURE FOR PROVIDING BLOCK-LEVEL STORAGE ACCESS OVER
SOCKET CONNECTIONS**

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Enclosed are the following:

- Specification in 21 pages;
- 6 sheets of drawings;
- A check in the amount of \$150 to cover the filing fee; and
- A return prepaid postcard.

The Commissioner is hereby authorized to charge any additional fees which may be required, now or in the future, or credit any overpayment to Account No. 11-1410. A duplicate copy of this sheet is enclosed.

Was this invention made by an agency of the United States Government or under a contract with an agency of the United States Government?

- No.
- Yes. The name of the U.S. Government agency and the Government contract number are:

60224664-081100

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**PROVISIONAL APPLICATION FOR PATENT
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Case No. **3WARE.011PR**

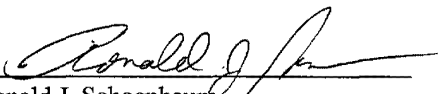
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Respectfully submitted,



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Attorney Docket No. : 3WARE.011PR
Applicants : Jewett, et al.
For : ARCHITECTURE FOR PROVIDING
BLOCK-LEVEL STORAGE ACCESS OVER
SOCKET CONNECTIONS
Attorney : Ronald J. Schoenbaum
**"Express Mail"
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Date of Deposit : August 11, 2000

I hereby certify that the accompanying

Transmittal in Duplicate; Specification in 21 pages; 6 sheets of drawings; Check for Filing Fee; and a Return Prepaid Postcard are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

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ARCHITECTURE FOR PROVIDING BLOCK-LEVEL STORAGE ACCESS OVER SOCKET CONNECTIONS

5 Background of the Invention

Field of the Invention

The present invention relates to storage systems for computer networks, and more specifically, relates to software architectures for providing block level access to storage resources on a network.

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Description of the Related Art

Various types of architectures exist for allowing host computers to share hard disk drives and other storage resources on a computer network. One common type of architecture involves the use of a central file manager. One problem with this architecture is that the failure of the central file manager can render the entire system inoperable. Another problem is that many software applications are not designed to use a central file manager.

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Some storage architectures overcome these deficiencies by allowing the host computers to access the storage resources directly over the network, without the use of a central file manager. Typically, these architectures allow the host to access the storage resources over a network connection at the block level (as opposed to the file level). One problem with this type of architecture is that the failure of an input/output request can cause other pending requests from the same host to be delayed. Another problem is that the architecture is highly vulnerable to network failures. The present invention addresses these problems.

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Summary of the Invention

The present invention provides an architecture for providing block-level access to storage resources, such as disk arrays, over a computer network without the need for a central file manager. An important aspect of the architecture is that concurrent input/output (I/O) requests from the same host computer are handled over separate

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logical network connections or sockets (preferably TCP/IP sockets). For example, a given host can establish two sockets with a given block server (storage server), and use one socket to perform one I/O request while using the other socket to perform another I/O request. As a result, the failure or postponement of one I/O request does not block or interfere with other I/O requests.

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Another aspect of the architecture is that the sockets can be established over multiple networks, including networks of different types and bandwidths, to provide increased fault tolerance. For example, a given host computer and block server can be connected by two networks that support the TCP/IP protocol, one of which may provide a much lower transfer rate than the other. As long as one of these networks is functioning properly, the host will be able to establish a logical connection to the block server and execute I/O requests.

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In a preferred embodiment, the software architecture includes a host-side device driver and a host-side reader/writer component that run on the host computers. The architecture also includes a server-side device driver and a server-side reader/writer component that run on the block servers. The reader/writer components are preferably executed as separate processes that are established in pairs (one host-side reader/writer process and one server-side reader/writer process), with each pair dedicated to a respective socket over a network. For example, if two logical connections are established between a given host computer and a given block server, each such socket will be managed by a different pair of reader/writer processes. The reader/writer processes and sockets preferably remain persistent over multiple I/O requests. The device drivers and reader/writer processes operate to export the block-level-access interface of the block servers to the host computers, so that the disk drives of the block servers appear to the host computers as local storage resources.

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In operation, when a host computer generates an I/O request, the host's device driver assigns the I/O request to an available reader/writer pair. The reader/writer pair thereafter operates as a dedicated proxy of the host-side device driver to execute the I/O request over a dedicated TCP/IP socket. Specifically, the host-side reader/writer process passes the I/O request over the socket to the server-side reader/writer process for delivery to the server-side device driver, and then handles any subsequent transfer of

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